Use of K_spiral, Bend, Jog, and Wiggle Shapes in Design of Railroad Track Turnouts and Crossovers

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the horizontal and superelevation geometry of the paths provided by railroad track switches.

2. Description of the Prior Art

The prior art relating to railroad switches in general is extensive. However, there are no known past uses of or references to railroad track switches whose two routes incorporate different amounts of superelevation.

The present invention includes use of two non-standard switch arrangements referred to as the transfer table and stub switch arrangements, which are known per se.

3. Additional background

International Application PCT/US01/41074, titled "Railroad Curve Transition Spiral Design Method Based on Control of Vehicle Banking Motion", discloses a method for design of railroad track transition spirals that will herein be referred to as K_spirals. International Application PCT/US03/09667, titled "Method for Designing Generalized Spirals, Bends, Jogs, and Wiggles for Railroad Tracks and Vehicle Guideways", presents a generalization of the foregoing method that can generate more complex transition shapes including transition shapes called Bends, Jogs, and Wiggles.

The present application makes use of the terms "point rail", "closure rail", "stock rail", "frog", "through" (applying to a route or path), and "diverging" (also applying to a route or path) to refer to otherwise known features of a traditional railroad track switch. The present application also uses the otherwise well known terms "superelevation" to indicate

the difference in elevation between the two rails of a railroad track, "straight" to refer to a switch in which one route is straight, and "equilateral" to indicate a switch whose two routes have equal and opposite curvatures.

SUMMARY OF THE INVENTION

International Applications PCT/US01/41074 and PCT/US03/09667, identified above, describe the use of K_spiral, Bend, Jog, and Wiggle shapes for design of track in general, and International Application PCT/US03/09667 describes the use of the Jog shape as a basis for design of crossovers. In accordance with the present invention K_spirals, Bends, Jogs, and Wiggles are used in the design of turnouts and crossovers expanding upon use of the Jog shape disclosed in International Application PCT/US03/09667 as a basis for design of crossovers. The present invention has two components. In a first component, the above listed shapes are used for design of turnouts and crossovers with good dynamic characteristics. In a second component, the above listed shapes are used together with any of four mechanical switch arrangements that are explained below. In addition to providing a basic switching function these switch arrangements accommodate the superelevation inherent in the listed shapes. These arrangements are referred to herein as the transfer_table, stub_switch, wide_point, and compromise_point arrangements.

BRIEF DESCRIPTIONS OF THE DRAWINGS

Figure 1 illustrates the horizontal geometry of a simple Bend.

Figure 2 illustrates the superelevation of a Bend.

Figure 3 illustrates a Jog shape configured to serve as the shape of a crossover between two adjacent parallel tracks.

Figure 4 illustrates the superelevation of the Jog shape.

Figure 5 illustrates six Jog shapes connected to form a pair of crossovers incorporating equilateral switches.

Figure 6 illustrates one Jog shape and two Wiggle shapes connected to form a single crossover incorporating equilateral switches.

Figure 7 illustrates the superelevation of the three routes through the crossover of Figure 6.

Figure 8 illustrates the coordination between the horizontal and vertical (or superelevation) shapes of the Jog shape.

Figure 9 illustrates a transfer table configured to switch between the through and diverging routes on the diverging side of the switch.

Figure 10 illustrates what is meant by a stub switch.

Figure 11 illustrates one mechanical arrangement for achieving the motion that the diverging side stub switch rail needs to perform in order for that rail to conform to the geometry of the K_spiral, Bend, or Jog shape.

Figure 12 illustrates the diverging stock rail and the through point rail of the wide_point switch arrangement.

Figure 13 illustrates the compromise_point arrangement.

Figure 14 is similar to Figure 8, illustrating features of the compromise_point arrangement.

DESCRIPTION OF PREFERRED EMBODIMENTS

1. Overall shapes for turnouts:

Considering the sloping line on the left side of Figure 1 to represent the through path of a straight track switch, and assuming that the diverging route leads to a tangent track whose compass bearing angle differs from that of the through path by a relatively small amount, the Bend shaped curve of Figure 1 will provide a good shape for the path of the diverging route of the switch. If the diverging route leads directly not to a section of tangent track rather to a section of track shaped as a circular arc, then a K_spiral would provide a good shape for the path of the diverging route of the switch. The K_spiral's left end would join smoothly with the through route and its right end would join smoothly with the circular arc. A special switch mechanism is needed in order for the superelevation illustrated in Figure 2 to be present in the diverging route of the turnout.

2. Overall shapes for Crossovers:

A crossover whose crossing path embodies the Jog shape illustrated in Figures 3 and 4 will have good dynamic characteristics. As with use of the Bend shape as the shape of a turnout, here also a special switch mechanism is needed in order for this superelevation to be present in the crossing route of the crossover.

Whereas the switches of the crossover of Figure 3 are straight switches (i.e., the through routes of those switches are straight), Figure 5 assumes so-called equilateral switches in which each route has some curvature but each route has only about one half the curvature of the diverging route of a corresponding straight switch. Equilateral switches are sometimes used to allow higher train speeds over diverging or crossing routes. As before, a special switch mechanism is needed in order for the illustrated superelevations to be present in the crossover.

Figure 8 can be thought of as a view looking along one of the through routes of a Jog shaped crossover with superelevation and looking at how the diverging stock rail of a superelevated switch drops and moves laterally with distance along the switch. Thinking of a traditional movable point switch in which the diverging stock rail maintains the same elevation as the other parts of the switch, when the switch is set to the through position the through point rail rests against the diverging stock rail and the weight of a wheel running (in the "facing" direction) on those two rails is transferred gradually from the

stock rail to the point rail as the point rail becomes wider in the direction of travel. If the elevation of the diverging stock rail is lowered relative to the elevation of the other parts of the switch as shown in Figure 8 and the through point rail maintains the same elevation as the other parts of the switch and also has its traditional narrow tapered shape, then it will be asked to bear the full weight of a wheel while it is still very narrow so that it will be crushed and the switch will fail. The four arrangements for providing a track switch function that allows superelevation of the diverging route referred to above are intended to deal with this problem.

3. Switch Arrangements embodying superelevation called for by the shapes

3a. Transfer_table

Considering Figure 9, the non-diverging side of a straight switch can use a conventional movable point rail because the rails on that side of the switch remain at the normal elevation. The two vertical lines in Figure 9 indicate the two ends of the transfer table. The table is shown in the position that makes the rails of the diverging path line up. The table is moved toward the diverging side (upward in the Figure) to bring it to the position in which the through path rails line up. The horizontal curvature of the diverging path rail on the transfer table can be seen in the Figure. The diverging path rail on the transfer table drops in elevation and rotates slightly with distance along the diverging route as called for by the superelevation of the relevant K_spiral, Bend, or Jog shape and as is mathematically described in International Application No PCT/US03/09667, which is incorporated herein by reference. In the case of an equilateral switch, where superelevation is needed for both routes through the switch, a transfer table needs to carry switch rails for both sides of the switch.

3b. Stub_switch

Figure 10 shows a stub switch arrangement that encompasses the rails on both sides of the switch. However, in accordance with the present invention, for the case of a straight switch, a stub_switch arrangement is needed only for the rails on the diverging side of the switch. The other side of the switch can use a conventional movable point rail for the

reason stated above for the case of the transfer_table arrangement. In the embodiment of the stub switch mechanism shown in Figure 11 the orientations and strokes (i.e., main bearing to crank throw dimensions) of the crank throws shown in the Figure vary with distance along the stub switch rail as needed so that in the diverging position the rail mounted above the rail carrier is in the prescribed position vertically and laterally and has the proper inclination. The two cranks are rotated through 180 degrees in order to move the stub rail between the through and diverging settings. In the case of an equilateral switch, where superelevation is needed for both routes through the switch, a stub switch mechanism is needed for both sides of the switch.

3c. Wide_point

In Figure 12 the lower rail that comes to a point on the left is the through point rail. It quickly becomes wide enough to carry the full weight of a wheel. At the point where the wide through point rail is wide enough to carry a wheel the diverging stock rail begins to drop in elevation. When the switch is set to diverge (i.e., the wide though point rail is moved away from the diverging stock rail), the gradual drop in elevation of the diverging stock rail provides the superelevation called for by the associated shape (K_spiral, Bend, Jog, or Wiggle). The downward curvature at the right end of the point rail in the Figure is appropriate if the rails are part of an equilateral switch. For a straight switch the wide through point rail would not be curved downward at the right side of the Figure. The wide_point arrangement can be used for equilateral switches.

3d. Compromise_point

The compromise_point arrangement of Figure 13 allows the use of a traditional style through point rail with a long taper. In this arrangement the elevation of the through point rail is lowered along with the elevation of the diverging stock rail until the point rail is wide enough to bear the full weight of a wheel. At the location where the through point rail has attained that width it stops following the descent of the diverging stock rail and turns upward so as to return to the elevation of the other rails just before it reaches the frog. This arrangement introduces a roll disturbance to the motion of vehicles over the through route of the switch. In order to limit that roll disturbance, the amount of

superelevation applied to the diverging route can be reduced so that the balancing speed on the diverging route will be less than it could otherwise be. The taper angle of through point rail can be increased slightly compared to the conventional taper angle so that the location at which the through point rail can bear the full weight of a wheel is closer than usual to its point. Such a reduction of taper angle will reduce the amount of roll disturbance introduced on the through route. To accommodate the added through point rail width associated with such a reduction of taper angle the diverging stock rail will need to be moved outward and this will cause the gage on the diverging route to be slightly wider in that area than it would otherwise be. Figure 14 is similar to Figure 8 but illustrates two features of the compromise_point arrangement, namely a lesser drop in elevation of the diverging stock rail and the corresponding initial drop in elevation of the through point rail as it descends with the diverging stock rail. The compromise_point arrangement is not applicable to equilateral switches.